



Modeling & Simulation Survey Briefing

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M&S Project Description

- **At the program level, obtain data concerning:**
 - types of M&S in use
 - how M&S are applied
 - who develops, owns & maintains M&S
 - how M&S are certified for use
 - the extent of programs' investment in M&S
- **Data collected from 21 programs, Mar-Sept '99**
 - Mixture of platforms, weapons, C4ISR
 - All Services
 - Contractor: Hicks & Associates, Inc.

Rationale: DOT&E is trying to find ways to make more use of M&S. Additional information was needed.

Project Motivation

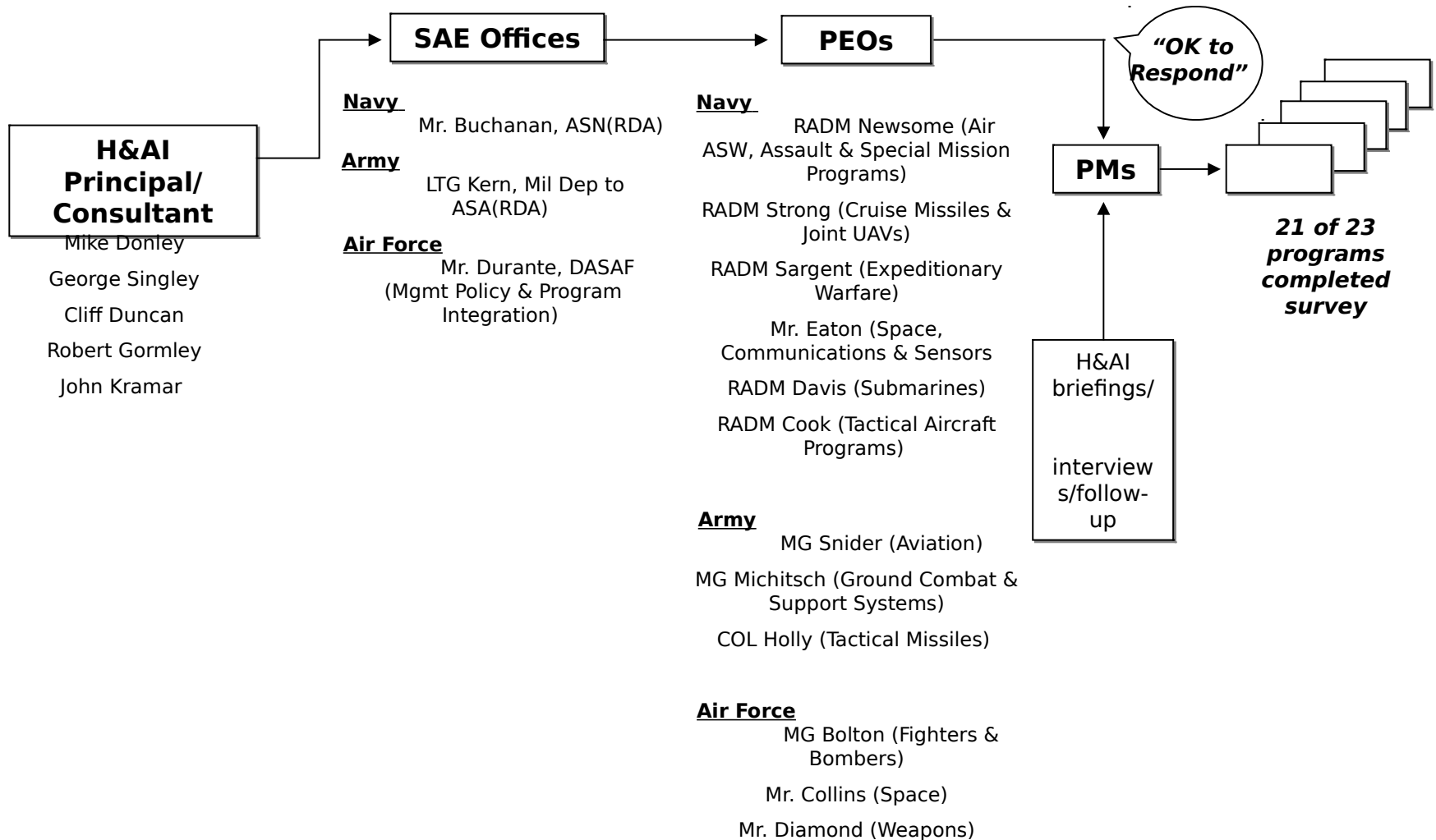
- **“T&E programs shall be structured to integrate all DT&E, OT&E, LFT&E and M&S...as an effective continuum” DoD 5000.2-R**
- **DoD acquisition policy and reform initiatives (e.g., simulation-based acquisition)**
 - M&S is becoming “an integral part of T&E planning, learning and understanding the system life-cycle”
- **Prominent joint themes (e.g., Interoperability, System of Systems) require balance between M&S and T&E**
- **DOT&E responsibilities require insight into/confidence in M&S**
- **Data needed to inform policy decisions on relationship of M&S to T&E**

Increasing dependence on M&S means programs must plan for M&S development, use and management

Actions Taken / Planned

- **Briefed study results to:**
 - DDR&E (2/23); DUSD(S&T)(12/27); DMSO (2/23)
 - SAEs (USAF 1/11, Army 1/18, Navy 1/20)
 - Participating Program Managers (2/24)
 - Industrial Committee on OT&E (2/28)
- **Establishing pilot programs with SAEs to examine how M&S could be better used to support T&E**
- **Will more thoroughly address M&S plans in program reviews, TEMP's and Test Plans**
- **Will work with DUSD(S&T) to**
 - Further develop M&S for operational test design
 - Potential use of HPC network
 - Improve migration of M&S applications from S&T to program offices

Initial Approach



Approach: Survey Content

MODELS & SIMULATIONS							← M&S “asset category”
Type	Name/Description/Owner	VV&A Status, Source	Activities Supported (Phase and Type)	Level/Source/Custodian of Funding	Man-Hours Spent	Overall Utility	← Survey questions

Environmental

- Authoritative Representations of the Environment

Combat

- Constructive Mission Models
- Constructive Campaign & Theater Models
- Constructive Engagement Models
- Virtual Prototypes
- HWIL Test Tools
- Constructive Threat Models
- Man-in-the-Loop Test Tools
- Live Simulations

Logistics

- Constructive Logistics Models
- Constructive Availability Models
- Constructive Maintainability Models
- Constructive Reliability Models
- Constructive Supportability Models

Engineering/Design/Manufacturing

Virtual 3-D Layout/Mockup of the System with a Behavioral Capability

- Virtual Manufacturing Plant Simulations
- Constructive Engineering Models
- Constructive Manufacturing Models

Training

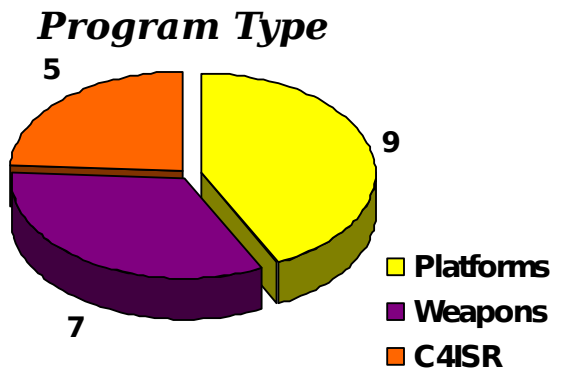
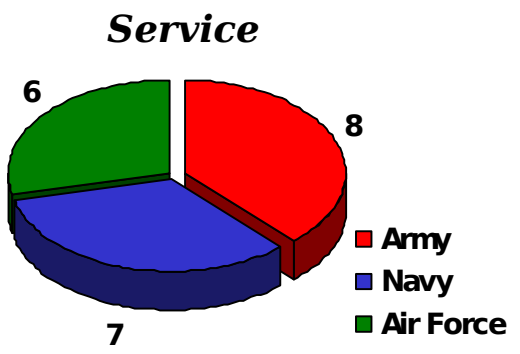
- Onboard Training Systems
- Virtual Crew Simulators

Types of Models and Simulations

Definitions of M&S types from DMSO SBA Roadmap

Summary of Survey Respondents to Date

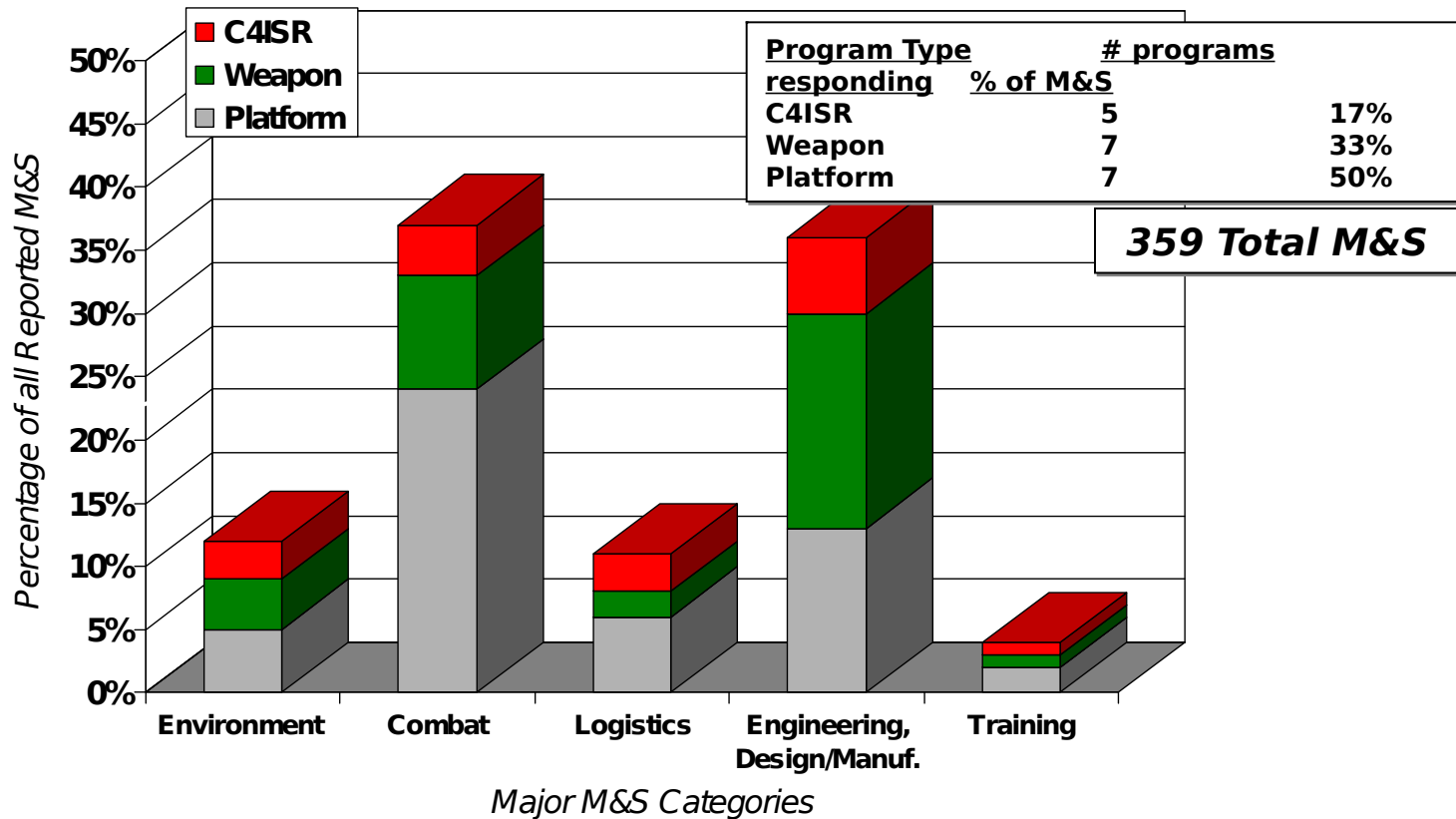
Program	Component	System Type	Current Status*	FRP Date*
Crusader	Army	Platform	MSII decision 2001	1QFY06
Comanche	Army	Platform	MSII decision FY02	1QFY07
M1A2 Upgrade	Army	Platform	FRP	3QFY94
ATACMS Blk II/BAT	Army	Weapon	LRIP	3QFY00
Javelin	Army	Weapon	FRP	3QFY97
SADARM	Army	Weapon	LRIP	4QFY98
FAAD C2	Army	C4ISR	FRP	3QFY95
C2 Vehicle	Army	C4ISR	LRIP	1QFY00
F/A-18 E/F	Navy	Platform	LRIP	3QFY00
V-22 Osprey	Navy/USMC	Platform	LRIP	2QFY00
LPD-17	Navy/USMC	Platform	EMD	3QFY07
AIM-9X	Navy	Weapon	LRIP	1QFY02
AN/BSY-2 (SSN-21)	Navy	C4ISR	Sea Trials on SSN-22 (USS CONNECTICUT)	N/A
UHF Follow-On	Navy	C4ISR	Completing FRP	4QFY88
SLAM-ER	Navy	Weapon	FRP	2QFY99
F-22	USAF	Platform	LRIP	3QFY03
B-2	USAF	Platform	IOC	N/A (did not enter FRP)
EELV	USAF	Platform	MSII Decision FY99	2QFY03 (MSIII decision 1QFY03)
ABL	USAF	Weapon	MSII decision FY03	2QFY05
SBIRS	USAF	C4ISR	MSII decision 1996	First GEO sat deliv. FY02; HEO FY03; LEO FY-04
SFW P3I	USAF	Weapon	FRP	3QFY96



*Source: DOT&E FY98 Annual Report to Congress

M&S Characterization

By Program Type



- *Types of M&S used driven partly by program type*
- *“Platform” programs utilized more total M&S assets and comparatively higher percentage of logistics and combat M&S types*
- *“C4ISR” programs utilized comparatively higher percentage of training M&S*

M&S Characterization

Common M&S

- **Combat Models**

- ALARM (2)
- ASAP (2)
- CASTFOREM (2)
- SUPPRESSOR (4)
- TRAP (3)

- **Engineering/Design/Manufacturing**

- ANSYS (2)
- APART (2)
- CATIA (3)
- COVART (3)
- DYNA 2D (2)
- ESAMS (3)
- FASTGEN (3)
- JSEM (2)
- Pro-E (5)

- **Logistics**

- COMPASS (2)
- LCOM (2)
- RELEX (3)
- TIGER (2)

- **Environments**

- EOSAEL (2)
- LOWTRAN (5)
- MODTRAN (2)
- NASTRAN (5)
- PATRAN (5)
- SINDA (3)

Exploiting M&S commonality:

- ***Best-of-breed?***
- ***Strengths/Weaknesses?***
- ***Limits on extension/application?***
- ***VV&A status?***

M&S Management Requirements for SBA, Acquisition Reform

Acquisition Reform

"Better, faster, cheaper material solutions"

- DoD 5000.1
- DoD 5000.2-R



**DSMC-
Develop
ed
Guidanc
e**

Simulation-Based Acquisition:

- Balance Requirements
- Explore Design Alternatives
- Establish Iterative Design Process
- Test as Integral Part of Design Process
- Conduct Decision Risk Analysis

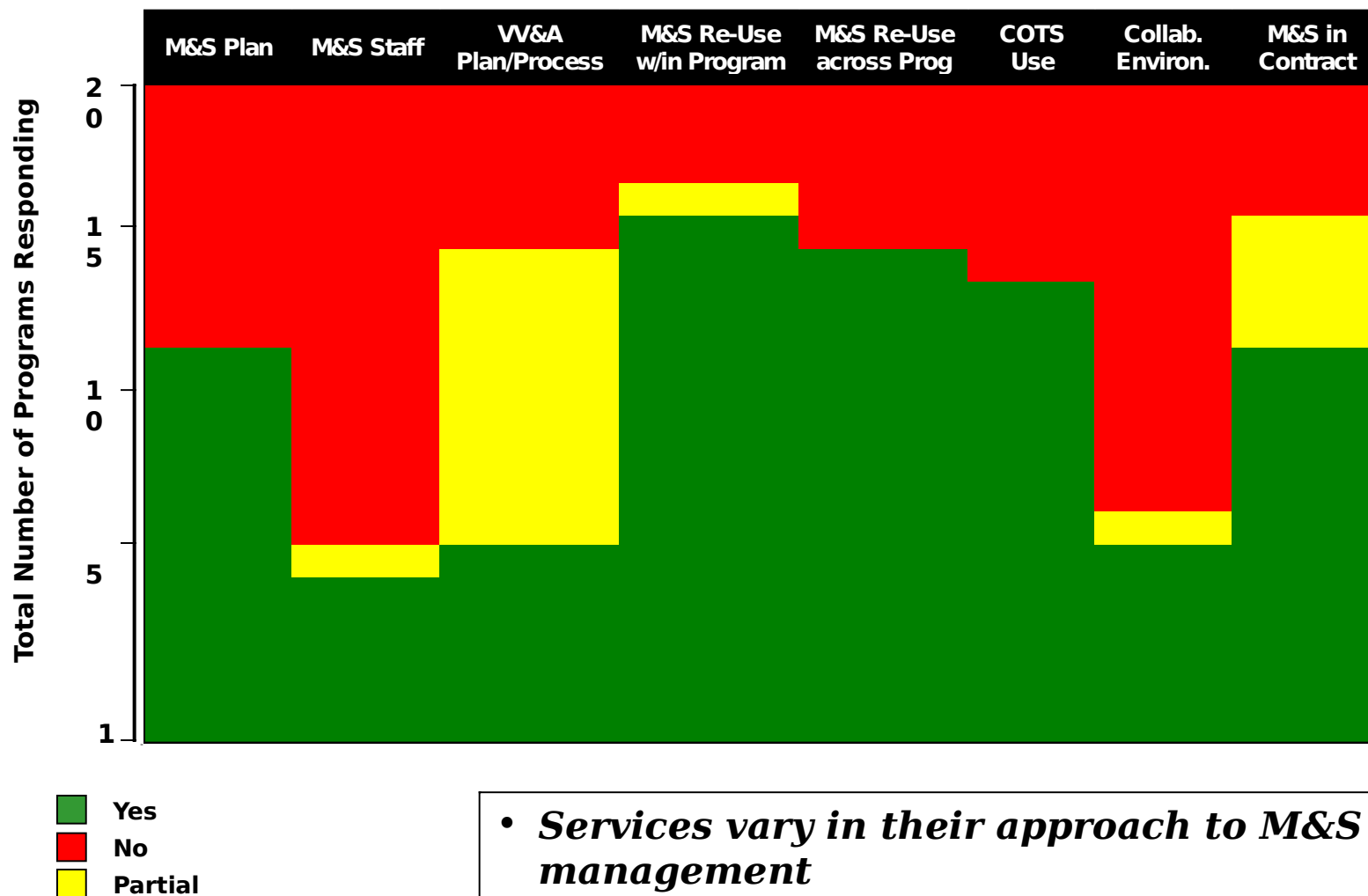
Process



Selected M&S Management Activities Deemed Critical to SBA Success:

- M&S Support Plan
- MS&A staff including users
- VV&A plan/process
- M&S re-use (incl. COTS)
- Collaborative environment
- Incentivized performance

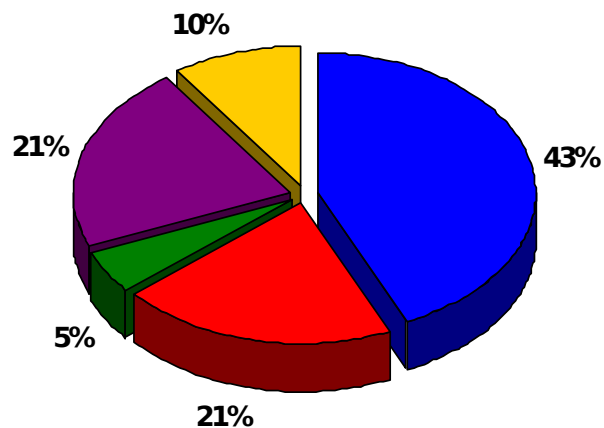
Incorporation of Selected M&S Management Activities



- *Services vary in their approach to M&S management*
- *Approach also varies by program maturity*

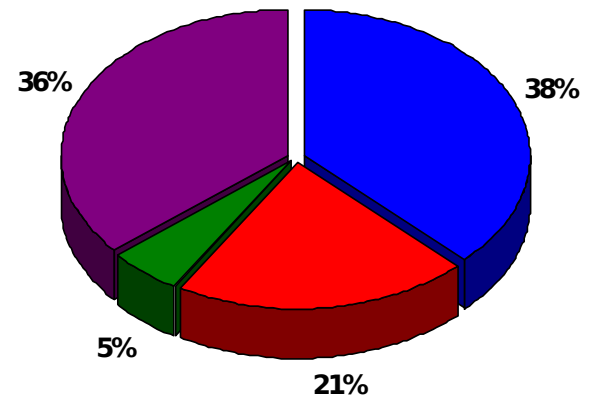
M&S Management

Developers



- 219 M&S from 13 programs
- Crusader, F/A-18E/F, Javelin, FAADC2, AIM-9X, ATACMS/BAT and Comanche did not provide data on M&S developers

Owners

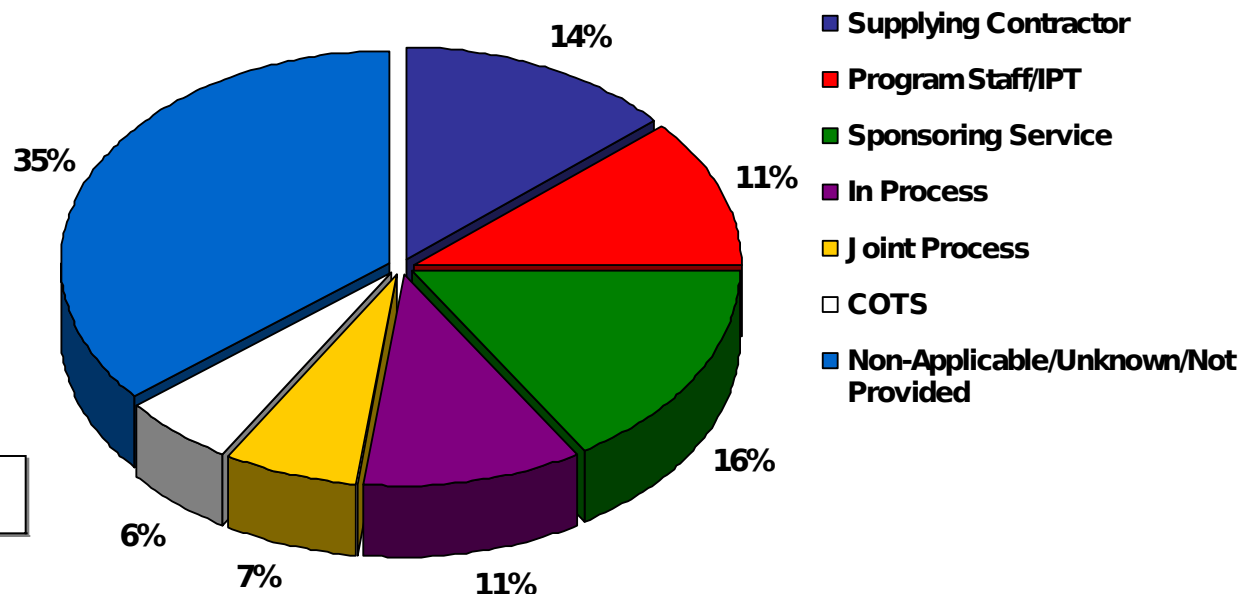


- 359 M&S

- **Industry is the predominant developer/owner**
- **Extent of industry involvement in Service/Government-developed M&S (30%) unknown**

VV&A Overview

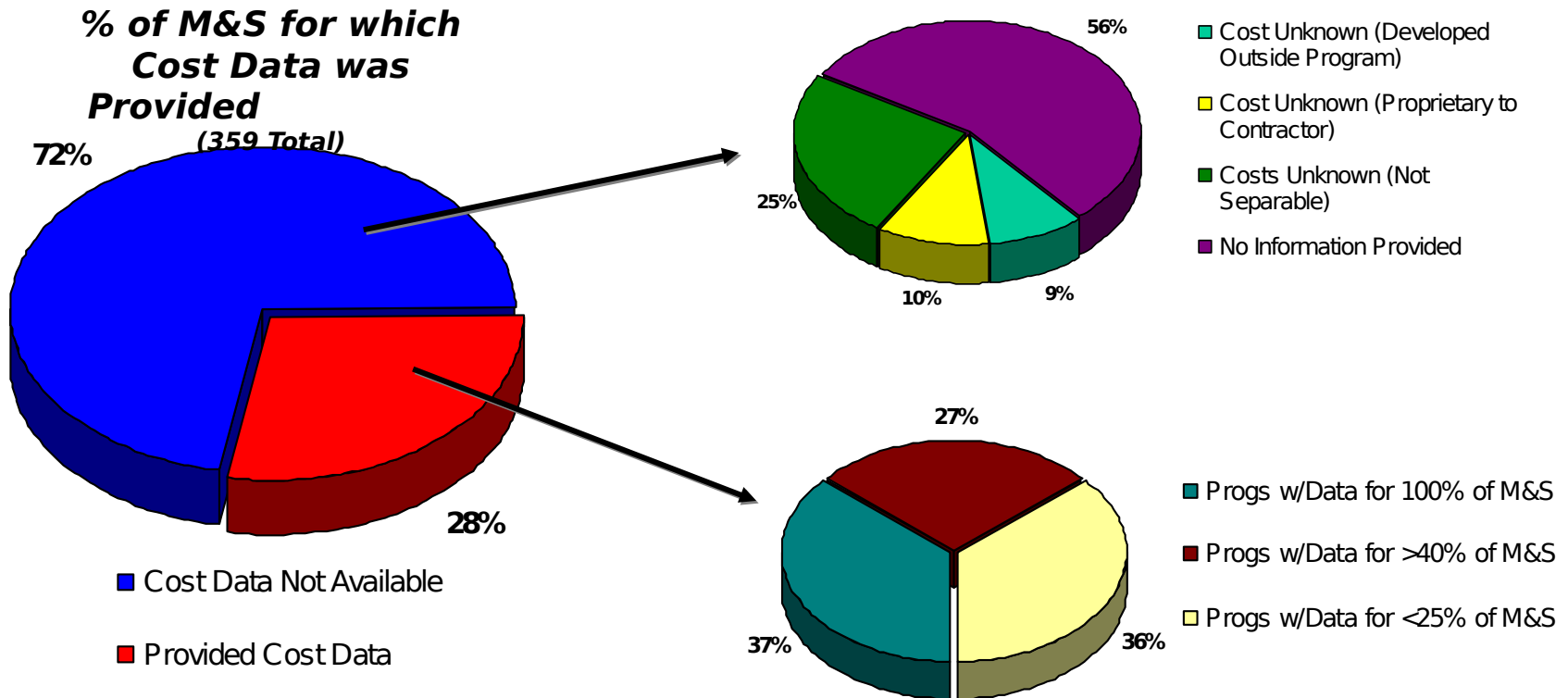
Who Does VV&A?



• 359 M&S

- ***Uncertainty about “pedigree” of M&S being used (35%)***
- ***Potential conflicts of interest (25%)***
- ***VV&A standards for COTS M&S?***
- ***Use of joint/independent processes low (7%)***

M&S Cost Overview



- M&S development and application costs data are not readily available within acquisition programs***

M&S Cost Summary

Program	Approx. Acquisition Cost	M&S Development Expenditures to Date	Reported M&S exp. to date as % of Total Acquisition Cost	% of M&S with Cost Data
LPD-17	\$10B	\$38M	<1%	100%
ATACMS/BAT	\$5B	\$25.2M	<1%	100%
Javelin	\$4B	\$48M	1.2%	100%
AN/BSY-2	\$3B	\$58.3M	1.9%	100%
SADARM	\$3B	\$14.6M	<1%	78%
V-22	\$37B	\$50.2M	<1%	44%
FAAD C2	\$1B	\$37.6M	3.7%	40%
SLAM-ER	\$5B	\$8.1M	1.6%	21%
F/A-18E/F	\$46B	\$15.1M	<1%	5%
SBIRS	\$8B	\$28M	<1%	<1%

M&S as Percentage of RDT&E: The ATACMS/BAT Example

RDT&E Expenditures to Date*	M&S Investment to Date*	M&S Investment as % of RDT&E Expenditures to Date*
\$1.46B	\$25.2M	1.7%

* Through FY99

Observations

- **Programs must invest early in M&S if M&S is to make a difference in acquisition**
- **PMs do not view DoD-wide M&S investments as cost or schedule effective**
- **Additional effort is required for M&S to support acquisition**
 - Increase use of M&S in program planning/design, execution, data analysis and archiving
- **Quality of M&S support to Program Offices needs review**
 - M&S suitability/credibility may be unknown or assumed
- **Future M&S requirements need to be identified**
 - Program Offices are “here and now” oriented
- **Need improved understanding of M&S management activities necessary for SBA success**
- **Building a business case for M&S is difficult**
 - Unavailability of cost data and return on investment
- **Industry plays a predominant role in M&S development and ownership**
 - source of expertise and substantial funding
 - impact of proprietary restrictions needs to be examined

Recommendations for USD (A,T&L)

- **Direct the implementation of a process to identify and satisfy M&S requirements for joint, coalition and system of systems development**
- **Emphasize the important role that acquisition programs must play in the development of M&S**
 - incentivize Program Office investment in M&S
 - address M&S in the 5000 series
 - have PEOs/PMs coordinate program plans, M&S assumptions, and performance predictions prior to testing
- **Review and clarify roles and functions of DoD M&S organizations**
 - “who’s doing what” and “who should be doing what”
 - gaps/overlaps
 - identify necessary revisions/additions to OPRs
 - e.g., assign responsibility for tracking total DoD M&S investment
 - identify and coordinate M&S priorities and funding source

Recommendations for USD (A,T&L)

- **Foster an improved understanding of the interrelationship of T&E and M&S**
 - Endorse pilot programs with the SAEs that examine and demonstrate the utility of M&S for T&E
 - add to list of issues for weekly luncheon meeting
 - background information to be provided by DOT&E
- **Examine payoff from M&S in life cycle cost**
- **Establish a forum to address industry strengths and challenges**